Kazuo SUZUKI*: Biosystematic studies of Japanese *Epimedium* (Berberidaceae) (2) Variation of the populations in Kyushu (Part 1)**

鈴木和雄*: 日本産イカリソウ属（メギ科）の種生物学的研究（2）九州における集団の変異（第1部）

As pointed out in the first paper of this series (Suzuki, 1978), the taxonomy of the genus *Epimedium* in Japan contains various problems to be examined further. In the same paper, it is reported that the populations in Shikoku can be grouped into two types. One of them shows a minor intra-populational variability, and the other type shows a larger one. Populations belonging to the former type have been classified into four species: *Epimedium diphyllum* Lodd., *E. kitamuranum* Yamanaka, *E. trifoliatobinatum* Koidz. and *E. grandiflorum* C. Morr. (s. l.). In populations of the latter type, some individuals that can not be adequately referred to any one of these species have often coexisted with one to three forms of the four species. It has been presumed that the origin of the latter type of populations may be more or less related with hybridization among the four species and that *E. kitamuranum* and *E. trifoliatobinatum* themselves would be of hybrid origin between the two extremes, *E. diphyllum* and *E. grandiflorum*. According to Shimizu (1960), the following four taxa of *Epimedium* are distributed in Kyushu: *E. diphyllum*, *E. kitamuranum*, *E. trifoliatobinatum* and *E. grandiflorum* var. *higoense* Shimizu. Various individuals which considerably deviate from typical forms of these taxa have been encountered, however, in examining herbarium specimens and during my field observations. The aim of the present work is to make clearer the taxonomic status of these plants by aid of population analyses and to inquire into the evolutionary differentiation of the populations in Kyushu.

Materials and Methods Populations sampled were chosen all through the range of *Epimedium*. Actually, 20 populations were used for this study. The localities are indicated in Fig. 1. Table 1 shows the outline of the habitat and

* Makino Herbarium, Faculty of Science, Tokyo Metropolitan University, 1-1, Fukazawa 2-chome, Setagaya, Tokyo 158. 東京都立大学理学部 牧野標本館.

** Continued from Journ. Jap. Bot. **55**: 225-231 (1978).
The present study was supported by the Grant in Aid for Co-operative Research from the Ministry of Education, No. 334041 (1978-1979).

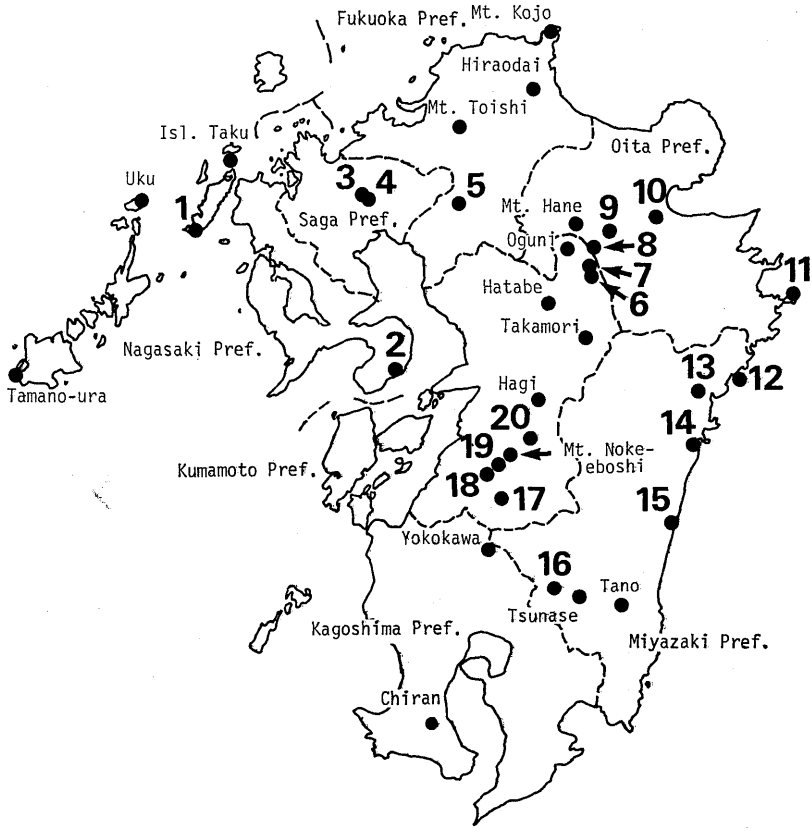

Fig. 1. Localities of the 20 populations. 1, Shijiki; 2, Arie; 3, Haruki-A; 4, Haruki-B; 5, Mt. Kora; 6, Senomoto-A; 7, Senomoto-B; 8, Mt. Waita; 9, Ukenokuchi; 10, Kijima; 11, Isl. Oshima; 12, Isl. Shimanoura; 13, Maino; 14, Zaikoji; 15, Kawaminami; 16, Chishanoki; 17, Ganjoji; 18, Sakaime; 19, Mizunashi; 20, Takenogawa. (cf. Table 1). Others are those of herbarium specimens used in this study.

size of each population, together with the sample size.

Sampling was made over the whole range of each population, except for four populations (11, 12, 16 and 17 in Fig. 1 and Table 1) which were too large to be surveyed in entirety. In the majority of the populations, more than 15 *Epimedium* plants were sampled. But, only eight and nine individuals could be collected from the population 3 and 5, because these populations were very small in size (Table 1). In three populations (18, 19 and 20), sampling was made

Table 1. Population samples of *Epimedium* in Kyushu

Locality	Population size* and habitat (altitude**)	Number of individuals collected
1. Nagasaki Pref., Shijiki	Medium; edge of oak forest, lowland, relatively dry	15
2. Nagasaki Pref., Arie	Medium; foothill, edge of *Cryptomeria* plantation (150m)	25
3. Saga pref. Haruki-A	Small; foothill, *Cryptomeria* plantation (100m)	8
4. Saga Pref. Haruki-B	Medium; foothill, *Cryptomeria* plantation (100m)	20
5. Fukuoka Pref., Mt. Kora	Small; sparse forest (250m)	9
6. Kumamoto Pref., Senomoto-A	Medium; grassland (850m)	20
7. Kumamoto Pref., Senomoto-B	Medium; edge of sparse forest, roadside (850m)	17
8. Oita Pref., Mt. Waita	Medium; grassland (900m)	18
9. Oita Pref., Ukenokuchi	Medium; sparse forest (850m)	28
10. Oita Pref., Kijima	Medium; roadside (600m)	22
11. Oita Pref., Isl. Oshima	Large; sparse forest, slope facing the sea	28
12. Miyazaki Pref. Isl. Shimanoura	Large; slope facing the sea	30
13. Miyazaki Pref., Maino	Medium; sparse forest, lowland	24
14. Miyazaki Pref., Zaikoji	Medium; sparse forest, lowland	16
15. Miyagaki Pref., Kawaminami	Medium; edge of copse, lowland	21
16. Miyazaki Pref., Chishanoki	Large; edge of copse, *Cryptomeria* plantation, roadside (250m)	30
17. Kumamoto Pref. Ganjoji	Large; sparse forest (150m)	26
18. Kumamoto Pref. Sakaime	Small; limestone cliff (600m)	6+10(2)
19. Kumamoto Pref. Mizunashi	Small; limestone cliff (600m)	20
20. Kumamoto Pref. Takenogawa	Small; limestone cliff (450m)	16

* small, ca. 5m×10m; medium, ca. 20m×50m; large, more than 50m×100m.
** An altitude is indicated only for population located in the upland.

twice from the same individual in the flowering and the fruiting stages. In Sakaime population (18), six individuals were collected in the flowering stage and ten in the fruiting stage where only two individuals were sampled in both stages. The population samples are preserved in MAK.

Besides the above samples, 15 herbarium specimens preserved in KAG, KYO, MAK, TI and TNS, and a living plant collected by Dr. Serizawa were used in the present work as additional materials. Their localities are also indicated in Fig. 1 (solid circles with a locality name).

The following characters were adopted to make the pictorialized scatter diagram to let it well represent the composition of each population: degree of development of the spur, length of the inner sepal, hairiness of the leaf, petiole length of the stem-leaf, number of serrations/midvein length of the leaflet, type of ramification to leaflets, and shape of the leaflet apex. Other characters such as flower color and frequency of biennial leaves were also examined but not adopted in the diagram since they could not adequately be incorporated. Leaf

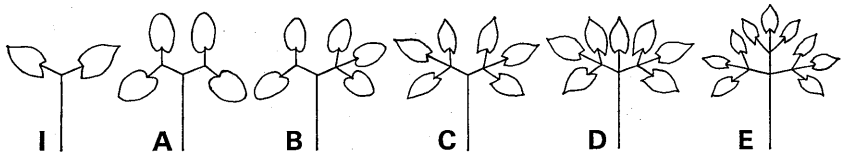

Fig. 2. Types of ramification to leaflets. I, bifoliate; A, bigeminate; B, intermediate between A and C; C, first geminate and then ternate; D, intermediate between C and E; E, biternate.

hairiness was examined on the fully developed leaves, the hairs of which are of the persistent type sensu Maekawa (1955) and Shimizu (1960). Bienniality of the leaves was observed in the field as well as in the experimental garden of Tokyo Metropolitan University where some selected individuals were transplanted from Kyushu. Symbols which represent the features of each character, except the type of ramification, are the same as those used in a previous paper (Suzuki, 1978). The ramification to leaflets has been classified into six types (Fig. 2), instead of four which were adopted previously. The symbols are indicated in Table 2.

Pollen fertility was estimated from the stainability in a cotton blue-lactophenol solution after the treatment with 45% acetic acid. The value for an individual was obtained by the observation of 200-500 pollen grains. The grains which stained deeply and uniformly were scored as fertile.

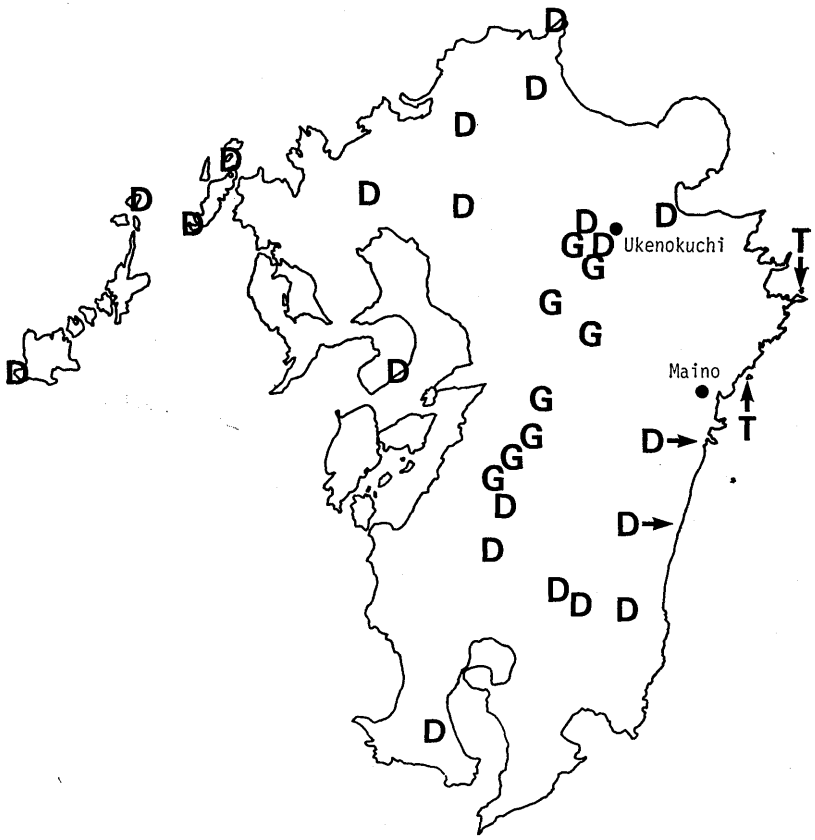

Fig. 3. Distribution of three species. D, *E. diphyllum*; T, *E. trifoliatobinatum*; G, *E. grandiflorum*. Localities of the problematical populations are also indicated with solid circles.

Results *Populations showing minor intrapopulational variability.* The results obtained have shown that most of the populations analyzed have a relatively low degree of intrapopulational variability. These populations are classified into three groups based on the discontinuity of morphological features: *E. diphyllum*, *E. trifoliatobinatum* (s. l.) and *E. grandiflorum* (s. l.). Fig. 3 indicates their localities.

E. diphyllum: Eleven populations appearing in Fig. 4 greatly overlapped in the range of morphological variability, and could therefore be integrated into one species, *E. diphyllum*. They had the following morphological features:

Table 2. Symbols for scatter diagrams

Character	Symbol					
Spur length (mm)	0	0.1 - 8.0		8.1 - 15.0		15.1 -
Ramification type (cf. Fig. 2)	A	B (A & C)		C	D (C & E)	E (I)
Hair density of the lower surface of leaves (number/6.25 mm²)	- 25		25 - 1			0
Hair density of the upper surface of leaves (number/6.25 mm²)	0		1 - 10			10 -
Leaflet apex type	obtuse		almost acute (intermediate)			acuminate
Petiole length of a stem-leaf (mm)	- 2.5					2.5 -

short inner sepals (less than 10 mm), spurless petals, bigeminate or bifoliate leaves, scanty serrations, densely hairy lower surface and glabrous upper surface of leaves, obtuse apices of leaflets, and predominantly annual leaves. These populations were found in the lowlands and often on sunny and relatively dry foothills (Table 1).

The populations distributed in northern Kyushu (Nagasaki, Saga, Fukuoka and Oita Prefs.) were often included somewhat atypical individuals that have such features as numerous serrations (Fig. 4; 1, 8, 10), longer sepals (1-4), almost acute apices of leaflets (1-4), and biennial leaves (1-5). In contrast, the southern populations were much more uniform (Fig. 4, 14-17).

Herbarium specimens from the following localities were identified to belong to this species: Tamanoura, Uku, Isl. Taku in Nagasaki Pref.; Mt. Toishi, Hiraodai, Mt. Kojo in Fukuoka Pref.; Mt. Hane in Oita Pref.; Hatabe in Kumamoto Pref. and Chiran in Kagoshima Pref. (Figs. 1 and 3). It was observed that two specimens from Mt. Kojo had the C-type ramification which is a characteristic of *E. kitamuranum* and *E. trifoliatobinatum*. These specimens, however, were close to *E. diphyllum* in other morphological features and were referred to this species.

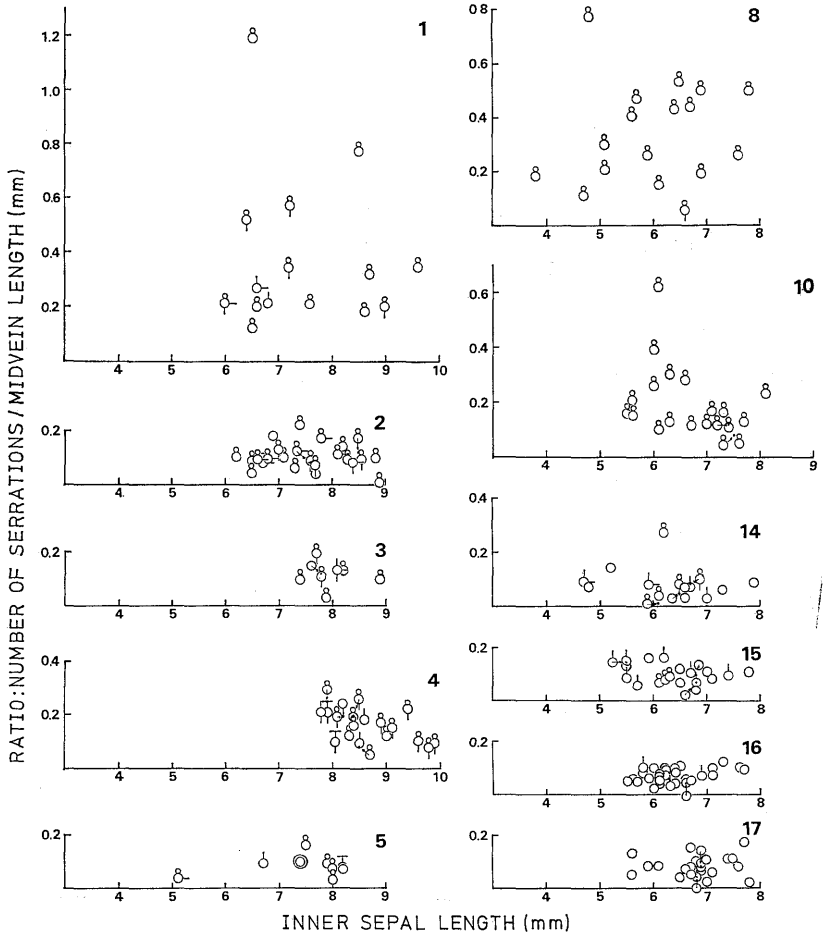

Fig. 4. Scatter diagrams showing the character correlations from 11 populations. 1, Shijiki; 2, Arie; 3, Haruki-A; 4, Haruki-B; 5, Mt. Kora; 8, Mt. Waita; 10, Kijima; 14, Zaikoji; 15, Kawaminami; 16, Chishanoki; 17, Ganjoji—*E. diphyllu*m. Symbols are shown in Table 2. The numerals correspond to the population numbers in Table 1 and Fig. 1; the same in the rest of the diagrams.

E. trifoliatobinatum: Two populations (11 and 12), found in sunny slopes facing the sea and being very similar morphologically (Fig. 5), were in agreement with *E. trifoliatobinatum*. They showed long sepals (9-17 mm), short spurred petals (9-15 mm), bifoliate or first geminate and then trifoliate leaves,

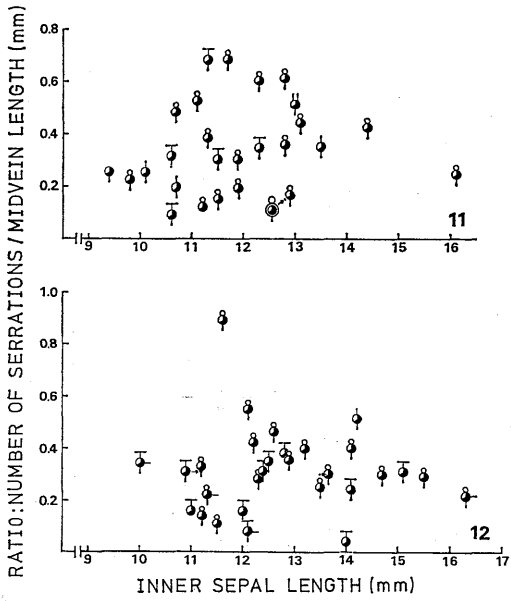

Fig. 5. Scatter diagrams showing the character correlation in the collections from two populations. 11, Isl. Oshima; 12, Isl. Shimanoura—*E. trifoliatobinatum*. Legends for symbols as in Table 2.

a small number of serrations, hairy lower surface and glabrous upper surface of leaves, almost acute apices of the leaflets and biennial and hardened leaves.

Bienniality and hardening of leaves are characteristics that were scarcely observed in the populations of *E. trifoliatobinatum* distributed on serpentine areas in Shikoku. (to be continued)

□宮城植物の会（編）：**宮城の自然をたずねて—野山の植物**. 233 pp.+11 カラー・プレート. 1980. 第一法規出版. 東京 ¥1900. 本書は宮城県の植物に親しんでもらうことを目的として，一般の人々を対象に書かれたものである。簡単に行ける場所として蔵王山と仙台市の太白山と佐保山とを選び，そこでみられる植物の中から約 100 種をとりあげて，近縁種との比較，県内の分布，利用，などについてやさしく解説している。索引をみると 700 種以上の植物名がでている。宮城植物の会の内藤俊彦，木村中外氏他 7 氏が分担執筆し，各種にモノクロームの写真がつき，植生や主なものにはカラー写真がある。宮城県には1935年の村井三郎氏の宮城県植物目録があるが，最近にまとめられたものがないため，ヒメサユリ，レンゲショウマ，ムヨウランなど思いがけない種類が載せられている。（大橋広好）